

Center for Applied Energy Research



HTFmetro - Precise metrological characterization of thermophysical material data for reliable heat metering in heating networks

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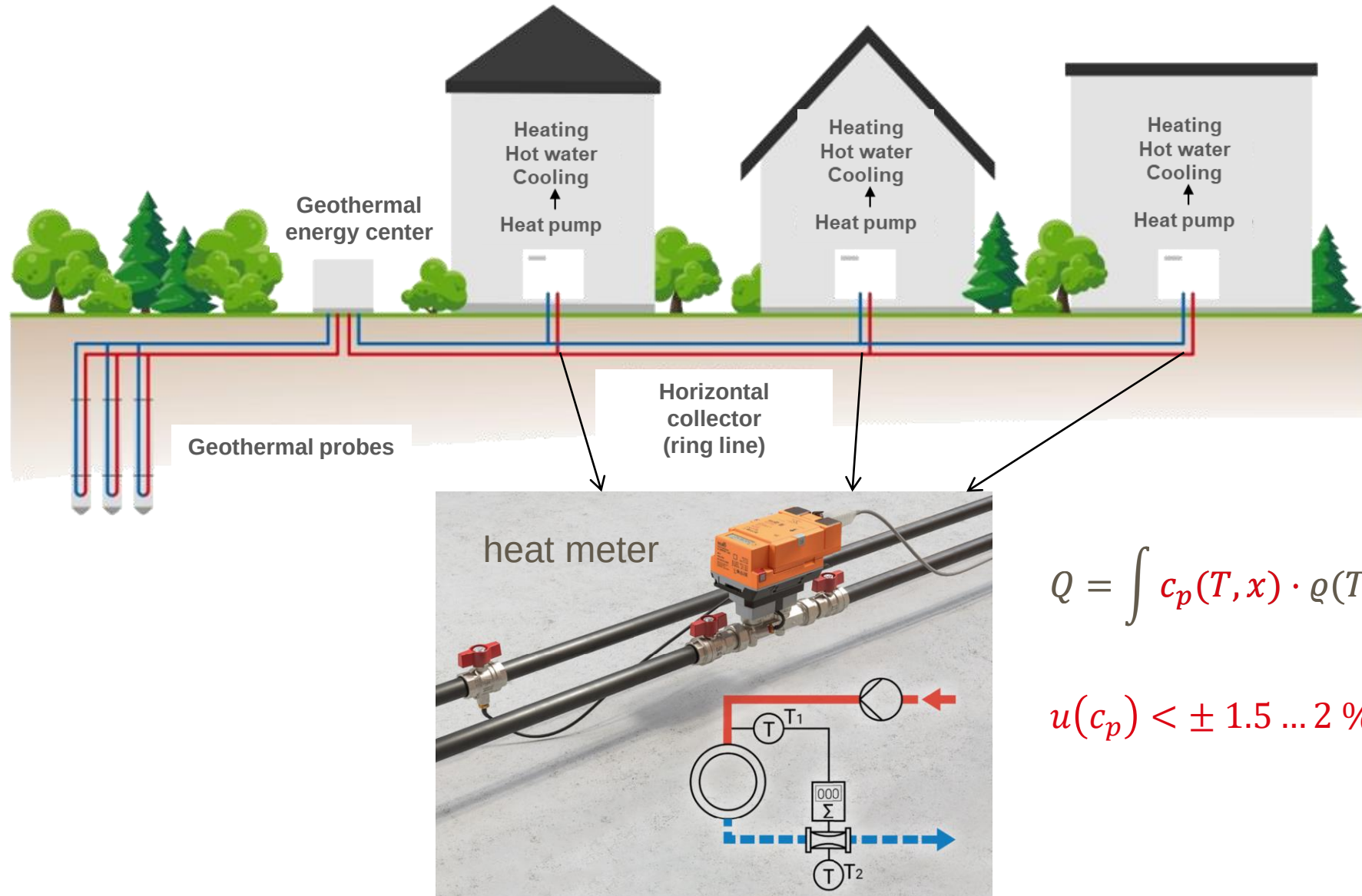


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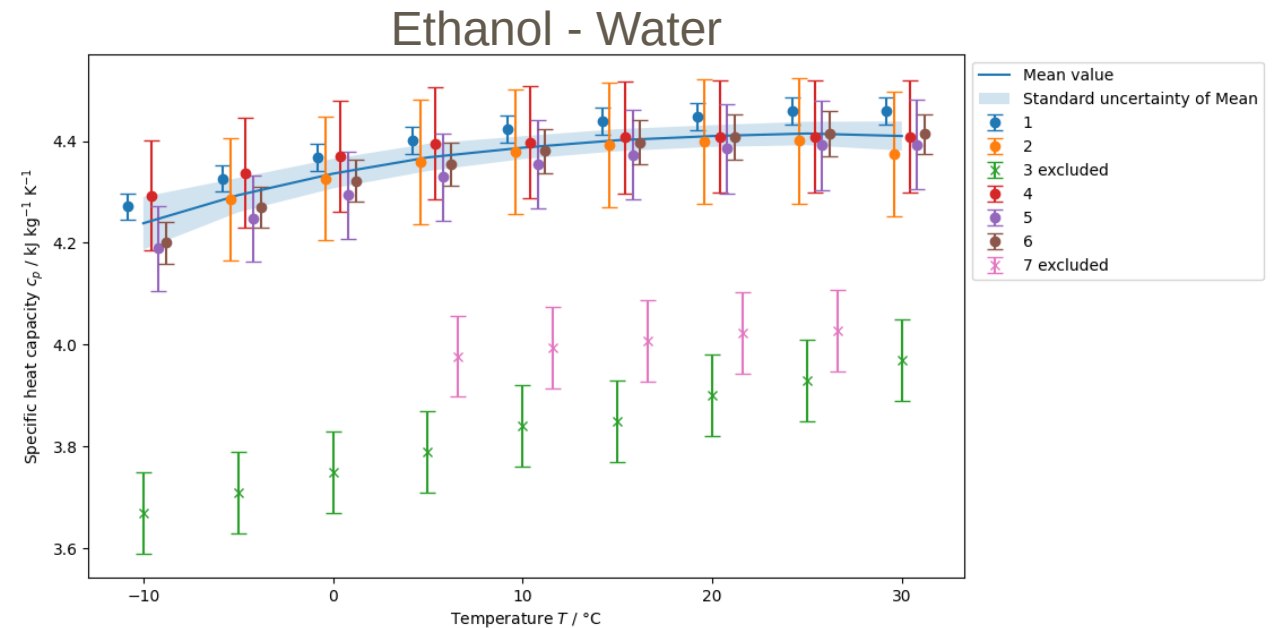
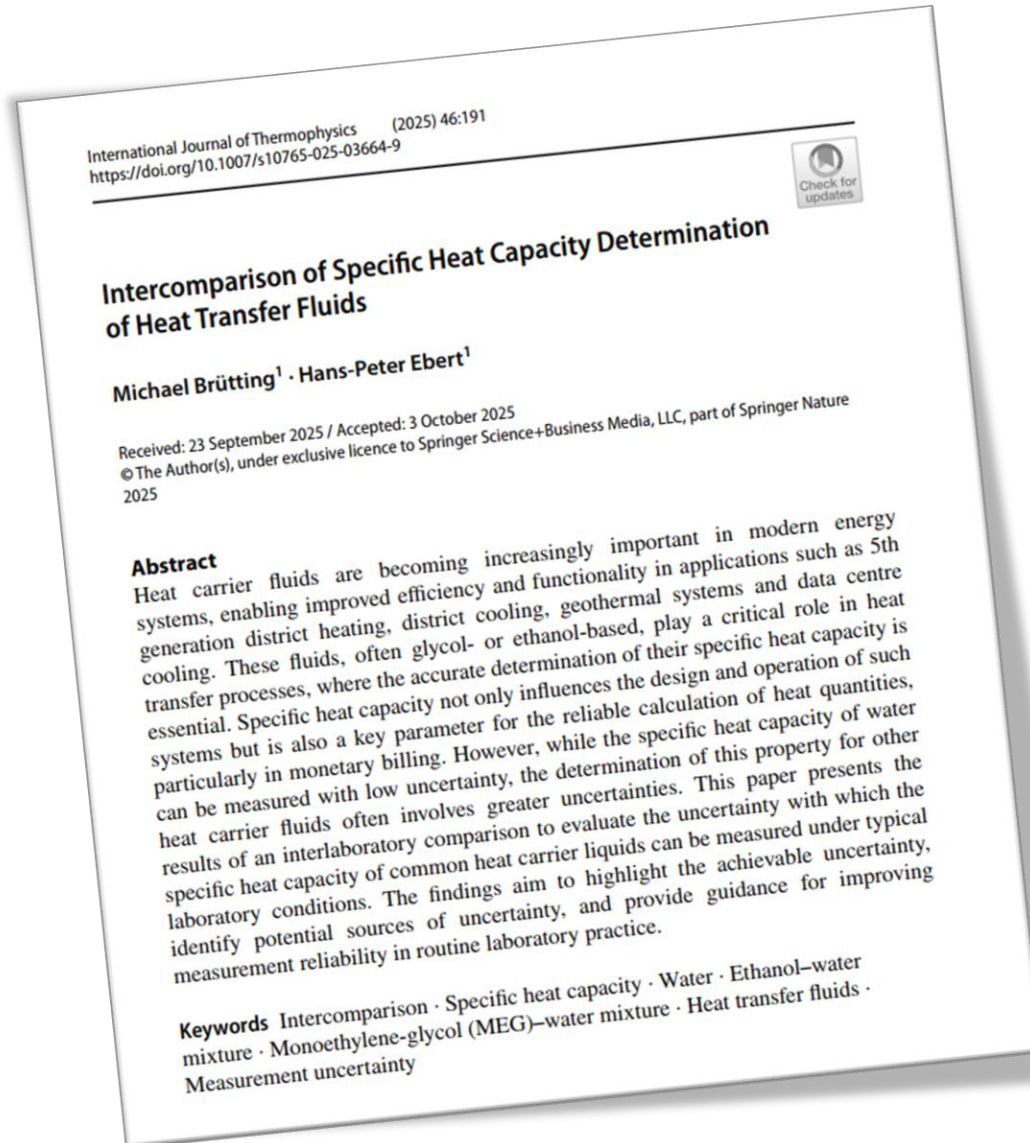
5th Generation District Heating Networks



$$Q = \int c_p(T, x) \cdot \rho(T, x) \cdot \dot{V} \cdot (T_2 - T_1) dt$$

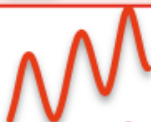
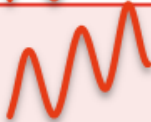
$$u(c_p) < \pm 1.5 \dots 2 \%$$

2024 / 2025: Intercomparison of the Specific Heat Capacity of Heat Transfer Fluids



<https://ak-thermophysik.de/>

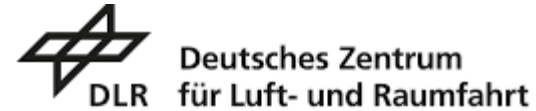
Measurement Methods

Measurement Method			Specimen Volume	Device	Crucible
DSC constant heating rate			35 µl	NETZSCH DSC 204 F1 Phoenix	Aluminium
DSC constant heating rate			35 µl	NETZSCH DSC 204 F1 Phoenix	Aluminium
DSC constant heating rate			850 µl	Setaram calorimeter, MicroDSC7 Evo-1A.	Hastelloy C276
DSC modulated temperature			40 µl	TA Instruments Q2000	Aluminium
DSC modulated temperature			40 µl	Mettler Toledo DSC2/700	Aluminium
DSC stepwise heating			850 µl	Setaram calorimeter, MicroDSC7 Evo	Hastelloy C276
Dynamic Hot-Wire Method according to ASTM D7896-14			>15000 µl	Commercial	not relevant

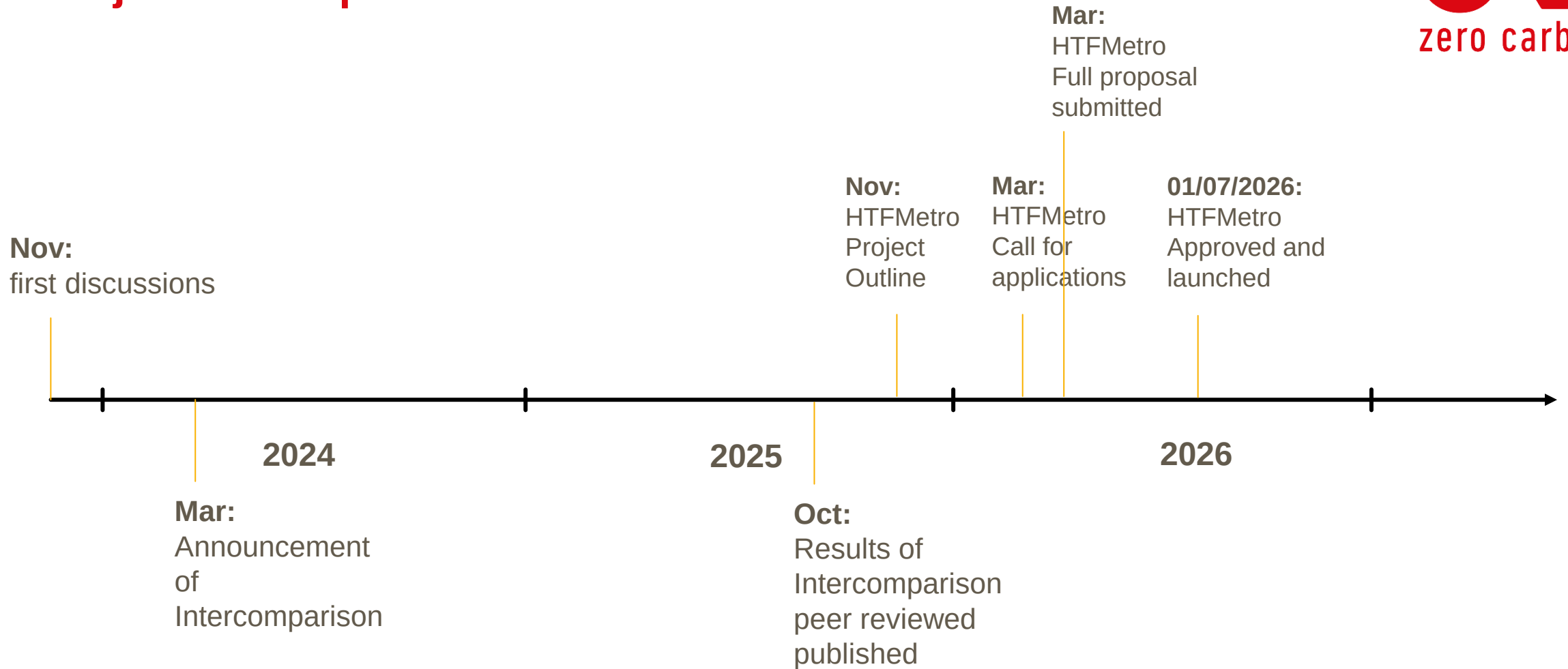
Involved Participants and Partners



**European Metrology Association
for Thermal Energy Measurement EMATEM e. V.**



Project development HTFMetro



Project HTFMetro

Precise metrological characterization of thermophysical material properties for reliable heat metering in heating networks

Duration 36 months
Project start 01.07.2026

Total project budget: 1.70 Mio €
Total funding volume: 1.35 Mio €



Gefördert durch:



aufgrund eines Beschlusses
des Deutschen Bundestages



HTFMetro Subprojects



Development and validation of appropriate measurement methods and scientific modeling of aging effects

- Main objective: To develop metrologically validated measurement and modeling methods for the precise determination of thermophysical property data for real heat transfer fluids, taking into account operational and aging effects.



Development of an **SI-traceable reference system** for flow calorimetry of heat transfer fluids

- Main objective: To establish an SI-traceable national standard for flow calorimetry to ensure legally compliant heat metering with a target uncertainty of $< 1\%$.



Investigation of the **influence of chemical composition on thermophysical properties** and long-term stability

- Analysis of the influence of additives (e.g., corrosion inhibitors) on thermophysical properties.
- Systematic study of aging caused by thermal stress and oxidation.



In-situ instrumentation and validation of correction models in **real-world demonstration** facilities

- Main objective: To reduce the fluid-induced additional measurement uncertainty in practical heat measurement to $< 1.5\%$ by integrating validated material data and correction models into the measurement instrumentation.

Thanks to the Supporters of HTFMetro



HTFMetro Goals



- the metrological **characterization of key material properties** across the relevant temperature range,
- the evaluation and **improvement of existing measurement methods**,
- the development of **new approaches for validating material properties** during operation,
- the investigation of the **influence of aging** on the measured variables,
- the provision of valid material properties to support **standardization and calibration**.

HTFMetro Next Steps

- Selection and characterization of **relevant heat transfer fluids**
 - Identification and selection of fluids (in particular, water-glycol and ethanol-water mixtures)
 - Systematic **analysis** and **prioritization**
 - Experimental **baseline characterization** (density, specific heat capacity, thermal conductivity and viscosity)
- Design and construction of **reference calorimeters** at the CAE and the PTB
 - Comparison and **optimization of existing measurement methods**
 - **Design of flow calorimeters** for high-precision measurement of cp
- Identification of **demonstration facilities** for **field tests**